

Project 2
Robert Sun
10/16/2022

1.

Problem 1 can be written as a system of equations, like so:

$$x_1 = x_4 + 40 + 30 - 50$$

$$x_2 = x_3 + x_1 - 40 - 55 + 15$$

$$x_3 = 55 + x_2 - 15 + 40 - x_1$$

$$x_4 = x_2 + 50 - 15$$

Simplified and in a more matrix like form: Reduced Row Echelon form:

$$x_1 + 0x_2 + 0x_3 - x_4 = 20$$

$$-x_1 + x_2 - x_3 + 0x_4 = -80$$

$$x_1 - x_2 + x_3 + 0x_4 = 80$$

$$0x_1 - x_2 + 0x_3 + x_4 = 35$$

$$x_1 - x_4 = 20$$

$$x_2 - x_4 = -35$$

$$x_3 = 25$$

* x_4 Becomes a free variable S_1

Because Traffic flow cannot be negative according to Row 2 of the Reduced row echelon form $S_1 \geq 35$ Therefore the minimum traffic flow from C to A is 35

2.

- a. Because You assign a letter to a number in order, you can use an ASCII table to switch between the number representation and the letter quickly, MATLAB utilizes Unicode. Unicode is however backward compatible with ASCII so using an ASCII table I can see that

the Numerical Representation of letter + 64 = 'A'

Because the Project does not differentiate between capital and lowercase letters with encoding I have chosen capital letters to keep

my ASCII table location constant. Because spaces are not after the letter 'z' in the ascii table I will need to calculate spaces independently(Spaces are "32" on the ASCII table)

Creating Numerical Row String and turning it into defined Conversion list:

```
>> String = 'MY NAME IS ROBERT AND I LOVE VIDEOGAMES'

String =
MY NAME IS ROBERT AND I LOVE VIDEOGAMES

>> NUMREP = double(String)

NUMREP =

Columns 1 through 13
    77    89    32    78    65    77    69    32    73    83    32    82    79

Columns 14 through 26
    66    69    82    84    32    65    78    68    32    73    32    76    79

Columns 27 through 39
    86    69    32    86    73    68    69    79    71    65    77    69    83

>> NUMREP = NUMREP-64

NUMREP =

Columns 1 through 13
    13    25   -32    14     1    13     5   -32     9    19   -32    18    15

Columns 14 through 26
     2     5    18    20   -32     1    14     4   -32     9   -32    12    15

Columns 27 through 39
    22     5   -32    22     9     4     5    15     7     1    13     5    19
```

Updating Spaces(currently -32) to 27 using mapping toolbox addon command 'changem':

```
>> NUMREP = changem(NUMREP,27,-32)
```

```
NUMREP =
```

```
Columns 1 through 12
```

```
13    25    27    14    1    13    5    27    9    19    27    18
```

```
Columns 13 through 24
```

```
15     2     5    18    20    27    1    14    4    27    9    27
```

```
Columns 25 through 36
```

```
12    15    22     5    27    22     9     4     5    15     7     1
```

```
Columns 37 through 39
```

```
13     5    19
```

b.

mm1 has 28 elements to it needs 4 rows and 7 columns in order to be decoded

```
mm1 =
```

```
16    91   -31    69   -92   -81   272  -347   -50   -23   161  -191   -62   -18   178  -221   -40    28   127  -140   -86   -59   251  -317   -88   -69   252  -325
```

```
>> NUMREP = reshape(mm1,4,7)
```

```
NUMREP =
```

```
16   -92   -50   -62   -40   -86   -88
91   -81   -23   -18    28   -59   -69
-31   272   161   178   127   251   252
69  -347  -191  -221  -140  -317  -325
```

```
>> c = b^-1
```

```
c =
```

```
18     3    -7   -11
 8     1    -2    -4
-1     0     1     1
-4     0     0     1
```

Setting variable c to b^-1:

Solving:

```
>> c*NUMREP
```

```
ans =
```

```
19    14     5    15    15     5    20
 5    27    19    14    14    19    23
22    17    20    19    27    20    15
 5    21     9    27    20    27    27
```

```
>> d = c*NUMREP
```

```
d =
```

```
19    14     5    15    15     5    20
 5    27    19    14    14    19    23
22    17    20    19    27    20    15
 5    21     9    27    20    27    27
```

```
>> d = c*NUMREP+64
```

```
d =
```

```
83    78    69    79    79    69    84
69    91    83    78    78    83    87
86    81    84    83    91    84    79
69    85    73    91    84    91    91
```

```
>> char(reshape(d,1,28))
```

```
ans =
```

```
'SEVEN[QUESTIONS[ON[TEST[TWO['
```

Accounting for the fact that 27+64 on unicode table is '[' we can see that the code is 'SEVEN QUESTIONS ON TEST TWO'

Solving for mm2:

```
>> c*reshape(mm2,4,8)+64
```

```
ans =
```

67	71	70	83	83	80	91	69
72	69	91	73	85	65	67	91
65	91	66	83	66	67	65	91
78	79	65	91	83	69	83	91

We can see that, with exceptions of spaces the message is "CHANGE OF BASIS SUBSPACE CASE".

```
>> char(reshape(c*reshape(mm2,4,8)+64),1,32)
```

```
Error using reshape  
Not enough input arguments.
```

```
>> p = c*reshape(mm2,4,8)+64
```

```
p =
```

67	71	70	83	83	80	91	69
72	69	91	73	85	65	67	91
65	91	66	83	66	67	65	91
78	79	65	91	83	69	83	91

```
>> char(reshape(p,1,32))
```

```
ans =
```

```
'CHANGE[OF[BASIS[SUBSPACE[CASE[['
```

c.

No because the determinant equals 0, making the inverse undefined and the message impossible to decode.